

mation about the structure, stability, and dynamics of the disk. Using the basic thermal Keplerian disk paradigm, we consider in particular generalizations of the standard optically thin disk models needed to accommodate the extremely rich variety of dynamical phenomena exhibited by black hole candidates, ranging from flares of electron-positron annihilations and quasiperiodic oscillations in the X-ray intensity to X-ray novae activity. These in turn provide probes of the disk structure and global geometry. The goal is to construct a single unified framework to interpret a large variety of black hole phenomena. This paper will concentrate on the interface between basic theory and observational data modeling.

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P.1
511-90 AB5.00 **N94-31127**
NONLINEAR CALCULATIONS OF THE TIME EVOLUTION OF BLACK HOLE ACCRETION DISKS. C. Luo, Department of Space Physics and Astronomy, Rice University, P.O. Box 1892, Houston TX 77251-1892, USA.

Based on previous works on black hole accretion disks, I continue to explore the disk dynamics using the finite difference method to solve the highly nonlinear problem of time-dependent alpha disk equations.

Here a radially zoned model is used to develop a computational scheme in order to accommodate functional dependence of the viscosity parameter alpha on the disk scale height and/or surface density. This work is based on the author's previous work on the steady disk structure and the linear analysis of disk dynamics to try to apply to X-ray emissions from black candidates (i.e., multiple-state spectra, instabilities, QPOs, etc.).

P.1
512-90 AB5.0 **N94-31128**
EVOLUTION OF VAPORIZING PULSARS. P. McCormick, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

We construct evolutionary scenarios for LMXBs using a simplified stellar model. We discuss the origin and evolution of short-period, low mass binary pulsars with evaporating companions. We suggest that these systems descend from low-mass X-ray binaries and that angular momentum loss mainly due to evaporative wind drives their evolution. We derive limits on the energy and angular momentum carried away by the wind based on the observed low eccentricity. In our model the companion remains near contact and its quasiadiabatic expansion causes the binary to expand. Short-term oscillations of the orbital period may occur if the Roche-lobe overflow forms an evaporating disk.

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P.2
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CAN A VARIABLE ALPHA INDUCE LIMIT CYCLE BEHAVIOR AND EXPONENTIAL LUMINOSITY DECAY IN TRANSIENT SOFT X-RAY SOURCES? C. Meirelles Filho and E. P. Liang, Space Physics and Astronomy Department, Rice University, Houston TX 77251, USA.

There has been, recently, a revival of the stability problem of accretion disks. Much of this renewed interest is due to recent

observational data on transient soft X-ray novae, which are low-mass X-ray binaries. It is widely believed that nonsteady mass transfer from the secondary onto the compact primary, through an accretion disk, is the reason for the observed spectacular events in the form of often repetitive outbursts, with recurrence times ranging from 1 to 60 yr and duration time on the scale of months. Though not having reached yet a consensus about the nature of the mechanism that regulates the mass transfer, the disk thermal instability model [1-4] seems to be favored by the fact that the rise in the hard X-ray luminosity is prior to the rise in the soft X-ray luminosity, while the mass transfer instability model [5-7] seems to be hindered by the fact that the luminosity during quiescence is unable to trigger the thermal instability. However, it should be stressed that, remarkably, the X-ray light curves of these X-ray novae all show overall exponential decays ($L_d \sim \exp -t/t_1$), a feature quite difficult to reproduce in the framework of the viscous disk model, which yields powerlike luminosity decay. Taking into account this observational constraint, we have studied the temporal evolution of perturbations in the accretion rate, under the assumption that α is radial and parameter dependent. The chosen dependence is such that the model can reproduce limit cycle behavior (the system is locally unstable but globally stable). However, the kind of dependence we are looking for in α does not allow us to use the usual Shakura and Sunyaev procedure in the sense that we no longer can obtain a linearized continuity equation without explicit dependence on the accretion rate. This is so because now we cannot eliminate the accretion rate by using the angular momentum conservation equation. In other words, the stress now depends upon the surface density, the scale height of the disk, and the accretion rate. If we write the viscosity parameter as

$$\alpha = \alpha_0 f$$

where we have included the r -dependence in α_0 and the parameter-dependence in f , we obtain the linearized angular momentum conservation equation

$$\frac{\delta f}{f_0} = \frac{4}{3} R \frac{\partial}{\partial R} \left(-\frac{\delta \dot{M}}{\dot{M}_0} + u + 2h \right)$$

the linearized continuity equation

$$\Sigma_0 \frac{\partial}{\partial t} u = \frac{1}{2\pi R} \frac{\partial}{\partial R} \delta \dot{M}$$

and the linearized energy equation

$$(8 + 51\beta_0 - 3\beta_0^2) \frac{\partial}{\partial t} h + 3(1 + 3\beta_0 + 4\beta_0^2) \frac{\partial}{\partial t} u =$$

$$\frac{2}{3} (5 + 18\beta_0 + 9\beta_0^2) \alpha_0 \Omega_0^2 \frac{\partial^2}{\partial R^2} \left(u + 2h - \frac{\delta f}{f_0} \right) +$$

$$3\alpha_0 \Omega \left[2(1 + \beta_0) u + 2(5\beta_0 - 3) h - \frac{\delta f}{f_0} \right]$$